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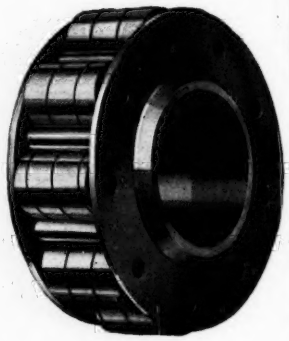

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Volume 3 APRIL, 1922 Number 4

Recent Developments in Farm Buildings*

By **Fred C. Fenton**

Mem. A.S.A.E. Associate Professor of Agricultural Engineering, Iowa State College

DURING the past two years there has been very little development along farm-structures lines. For the most part new farm structures were brought forth in response to a need or demand on the part of the farmers.

There is a widespread interest and, consequently, some development in the construction of the Gothic arch barn frame. Since its first appearance in the Northwest some fifteen years ago it has grown in favor steadily. It is popular because of its pleasing exterior appearance and because it gives a haymow entirely free from interior braces. It may also be adapted to almost any width barn.

These barns were first developed near the lumber mills of the Northwest where the lumber could be cut without much trouble to the curvature of the roof. The ribs or rafters commonly were made by nailing together three or more 1x10-inch boards to form a curve. These boards can be prepared best at a sawmill where a power saw is available. The sawmill in the West made the practice of preparing and selling the boards cut to the proper radius. In the Middle West this type lost favor because of the labor of preparing the lumber in the absence of power-driven saws.

In 1916 the first bent rafters made their appearance. An experiment with the bent rafter conducted at Davis, California, in 1916 is the first one brought to my attention. In this construction the boards are bent to the desired curve instead of being sawed out. The ribs are commonly made of four or five one-by-four's bent and securely nailed and bolted together with joints spaced so that no two will be closer than three feet. The construction of these ribs is simple and the erection also is very easy. All of these barns built in the Northwest seemed to have been strong enough, and the numerous examples of the bent rafter in the Middle West seem to show that this design is also strong enough.

The curve of the roof may vary considerably. A common method is to make the rafters with radius two-thirds of the width of the barn. This makes the top of the roof rather flat. A three-quarter-width radius makes the roof a bit high and peaked. The best design seems to be using a three-quarter-radius from a point three feet below the lines of the top of the studding.

In the absence of experimental data there seems to be two weaknesses in these roofs, where the radius curvature is small and the top of the roof is rather flat. In some cases there has been a tendency to sag at the middle of the barn. Also this flat portion is not suited to the use of wood shingles. The second weakness is the joint between the bent ribs and the wall of the barn. When no tie is used other than the toe-nailing of the rafters to the plate it would seem to be a very weak point. Ties running vertically from the rib down to the floor joist are used, spaced every eight feet. It is questionable whether these are adequate.

*Paper presented at the fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27, 28, and 29, 1922.

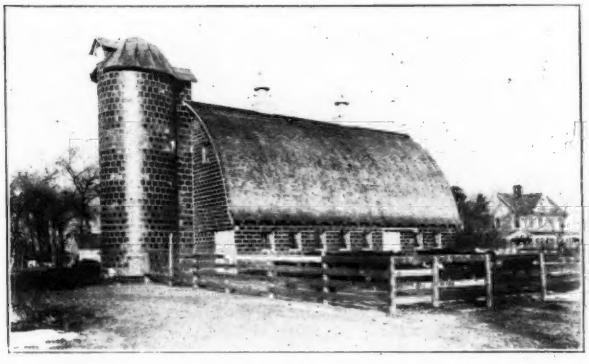
The combination built-up and bent-rafter type in the opinion of some makes a stronger barn. Built-up ribs of three one-by-twelve's sawed to the curvature, spaced eight feet apart, give the barn some rigidity which is lacking in the barn built of the bent rafters entirely. Headers made of 2x4-inch material are set in between the built-up ribs at intervals of four feet for stiffeners. Bent rafters made of four 1x3-inch material are spaced two feet on centers between the heavier ribs.

The weakness at the eaves is overcome by making the ribs continuous from foundation to the ridge, that is, the stud and rafter is one continuous built-up rib of five one-by-four's. This construction eliminates any weakness at the eaves. A later design of the Louden Machinery Company provides for a continuous rib running from foundation to foundation. This eliminates both joints at eave and ridge. The radius of curvature at the peak is twelve feet and the natural slope here is secured by two short rafters spiked to the ribs and braced in the center. F. C. Harris states that in the Louden experimental work it was found possible to bend this lumber to a ten-foot radius, providing a good quality of lumber was used.

Just what will be the most approved design of the Gothic roof will have to be worked out. The shape of the roof is growing in popularity and seems well suited to the type of barn required throughout the corn belt. There is need for some original research along this line.

Right along this line it might be well to mention the experimental masonry arch built at the Iowa station in 1915. The idea was to work out a roof of permanent fireproof nature that could be used on the concrete or clay block barns already designed. Results of this experiment have been reported before.

This Society has already been interested in the development of permanent construction. Clay blocks for barn-wall construction have reached an advanced stage, and to those



Gothic arch roof construction on a clay block barn

following farm buildings there is little new to be presented.

There are two new barn walls of concrete which may be of interest. One is a monolithic construction developed by the Denniston-Sprague Construction Company, Fergus Falls, Minnesota. The wall consists of solid walls strengthened by pilasters at intervals of six feet. The walls themselves are three inches thick and the pilasters are 8 by 8 inches projecting five inches outside of the wall. To prevent cracking and hold the walls together ⅜-inch rods spaced twelve inches apart run continuously around the barn. Each pilaster is reinforced vertically with three ⅜-inch rods.

The steel forms used to cast the walls are made under patent by the above company. They are made in sections 24 inches high and 6 feet long of 14-inch gauge sheet steel. These sections are reinforced with angle irons to secure rigidity. The construction of these walls seem to be simple. First, the pilaster forms are set up, then the sheet forms are bolted to them. Bolts extend through the pilasters to hold forms the proper distance apart. Door and window frames are set in at the proper places and the concrete poured. It is recommended that enough forms be provided for the entire barn. Set them all up at one time and pour continuously, but it is believed that two rows or units of forms would be sufficient. They could be raised and the wall poured in sections similar to the method used in silo construction. One complete set of forms for a 36 by 72 foot barn would cost about $1500. They would be practicable only for a contractor or perhaps a group of farmers.

The cost of materials in this wall is low. One barn 36 by 72 feet in size would cost as follows:

160 sacks of cement at 75 cents	$120.00
18 yards of sand at $2	36.00
Reinforcing steel	50.00
Total for materials	206.00
Labor, four men ten days at $4	160.00
	$366.00

Where the farmer could supply the sand and do most of the work a very cheap wall will result. A three-inch solid concrete wall will lose nearly as much heat by radiation as single glass. So this would be a cold wall with large heat loss, and a great deal of frost would form on the inside. For this reason it would be more suited to warm, dry climates where only cheapness and rigidity were required.

Another concrete barn which has attracted considerable attention is the one developed by the Valley Silo Company, Fargo, North Dakota. The designers of this barn state that their object was to secure a barn that would give warmth, dryness, and utmost rigidity and strength. Although this barn is similar in exterior appearance to the previous one, it is different since it is constructed of blocks and staves made at the factory and hauled to the farm. The staves are like common silo staves, 10 inches wide, 30 inches long, and 2¼ inches thick. The wall consists of two thicknesses of these staves with an air space between. The staves are held in place by piers or pilasters made of cement blocks cast at the factory. The blocks are 5½ by 10 by 13½ inches and provided with grooves on the sides into which the ends of the staves are fitted. Each pilaster is hollow from top to bottom to permit the placing of steel vertically, after which the cavity is filled with concrete. The horizontal joints of staves are set in cement mortar, while the ends are pointed up after being put in place. The corner blocks, lintels, and window sills require special design and are cast to fit into the general scheme.

The barn is easy to erect. The wall is tied down to the foundation by embedding bolts in the green concrete, allowing them to extend up into the pilaster about three stave lengths. Then 9/16-inch wall bolts are inserted into the hole in the pilaster, being long enough to extend from the foundation to a point six inches above the wall. The opening in the pier is filled with concrete, thus tying the two reinforcing rods together. The wooden plate is bolted solidly on the top of the wall, making a solid tie from the upper part of the barn to the foundation.

Gothic roof framing: bent construction at right, mixed bent and sawed shown at left

The joists of the hay loft are supported on 4x6-inch timbers which rest on special girder piers set into the pilasters.

The Valley Silo Company states that they have built forty-one of these barns, all of them giving satisfaction. The barn is very warm, with no frost or condensation on the inside. They do not crack or crumble, and are resistant to wind and fire.

There has been continuous improvement in the type of corncribs built. High-priced corn gave great impetus to the idea of preventing waste. The idea of an ideal crib should be to prevent waste of corn from all sources, such as mould, rot, rats, mice and fire. Besides this a crib must be strong and durable.

The Adel Clay Products Company, pioneers in the round tile crib, have lately improved their corncrib block. The former angle cut block had four square openings, furnishing an excellent place for sparrows to nest. The latest block has four long narrow vertical openings too narrow for birds or large rats.

The demand is for rectangular cribs with a driveway through the center and grain storage overhead. Such a crib was built on the Iowa State College grounds out of Adel tile in 1916. The walls were strengthened by heavy concrete pilasters, making a cumbersome and expensive type of construction. But we find the same idea worked out in the new Natco corncrib and granary. Some attempts have been made to build a clay-block corncrib wall with stiffeners or reinforcing, but they have never been very successful. In this crib the tile are made in two units, a 4x8x5-inch ventilated tile and the 5x8x12-inch pilaster tile. Pilasters are placed approximately six feet on centers. Where the crib walls are not more than ten feet high no reinforcing steel is used in the pilasters. But for the higher crib walls both horizontal and vertical steel rods are placed in the pilaster and openings are filled with concrete. The openings in the tile are so small that they are ratproof in themselves.

The crib is well designed and substantial. It presents an excellent appearance and can be built into the combination corncrib and granary with the central driveway, the type which has always been the most popular with the corn belt farmer.

The growth of the concrete ventilated stave corncrib has attracted considerable attention. Built of the regular silo stave 10 inches wide and 30 inches long, it is particularly adapted to the circular construction. The ventilation is furnished by two central openings, 4 by 9 inches in size, in each stave, giving about 20 per cent of the wall area in openings. These openings are filled with four quarter-inch steel

rods which run lengthwise of the stave and form a protective grating with openings close enough to exclude rats. The crib is held together by 9/16-inch steel rods so spaced that each stave has two rods to hold it. Some kind of interior ventilator is used to insure proper drying out of the corn at the center.

A combination corncrib and granary may be made out of these two units, using the solid staves for the small grain and the ventilated for ear corn. A roof is put over the two and an elevator installed permanently in the driveway.

Another design secures the combination grain-storage building by putting the grain above the driveway. The corncrib is semicircular in shape, which necessitates some strong beam construction at the driveway to which to tie the rods. The interior studding and the joist above are of wood so this is half concrete and half wood type of construction. The door frames may be made of concrete, and the steel bands tied to this solid concrete post. This is, no doubt, a more rigid structure. The end of the grain bins above is made of solid staves, leaving no wood subject to the weather on the outside.

Still another design is the one using steel beam construction for the driveway studding and the floor joist. Ventilated staves are fitted between the steel joists below and solid staves form the walls for the grain bins above. By using a fireproof type of roofing on this structure we have a very permanent and fireproof crib.

These concrete stave corncribs present a fine appearance. The gray stave with rods and roof painted green makes an attractive color scheme. These cribs are being built in numerous places throughout the corn states and are giving excellent satisfaction.

Discussion by A. W. Clyde

Assoc. A.S.A.E. Extension Professor of Agricultural Engineering, Iowa State College

THERE are a few features of the Gothic barn roof and other self-supporting roofs which I wish to discuss even at the risk of being called a "crepe hanger." I have been investigating the strength of such roofs with results that may be rather surprising.

My remarks on the Gothic barn roof will be limited largely to the bent-rafter type. In attempting to determine the strength of this construction it is necessary to make one fundamental assumption, namely, that the several one-by-fours or one-by-sixes can be bolted or nailed together so well that they will act as a unit. This is a doubtful assumption at best and, therefore, suggests that a more liberal factor of safety should be provided than would be the case in other kinds of construction. In other words, it is extremely unlikely that a bent Gothic rafter is as strong as it would be if it could be made in one piece. Bearing in mind this fundamental assumption we can analyze the rafter according to two conditions:

First: As a continuous arch with fixed ends. This condition is not yet realized in actual construction though designs have been made for it.

Second: As a three-hinge arch. This is very nearly the average condition. It is typified by the usual construction where the rafters rest on a plate and are spliced at the ridge with collar beams.

I have made analyses for both these conditions. In each case the construction and loading were taken as follows:

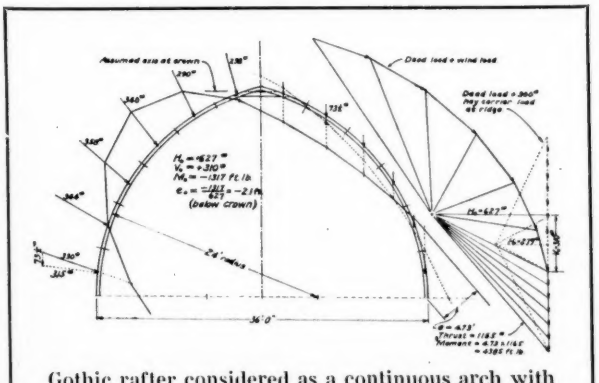
Span, 36 feet; rafters, five pieces of one-by-four curved to 24 feet radius, actual size 3¼ by 4 inches, spaced 24 inches apart; roof covering, one-inch boards and shingles; wind load, 30 pounds per square foot on vertical surface and decreasing on slopes according to Kidder's handbook; hay carrier load, three hundred pounds at peak on one rafter.

The spring line of the arch or the lower hinges were taken at the eaves, it being assumed that the walls would be braced at this point. The wind was chosen as thirty pounds per square foot or ninety miles per hour because I believe most of us have considered that barn roofs should stand this load.

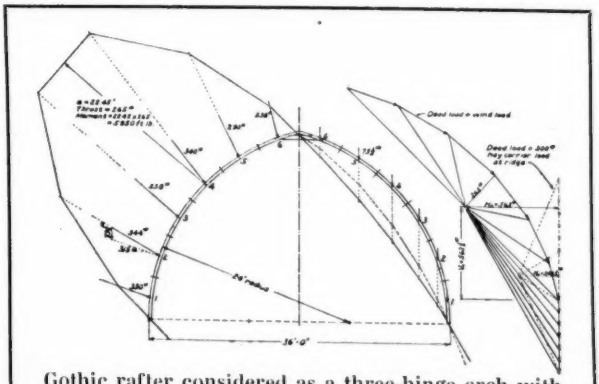
First condition, continuous arch with fixed ends (Fig. 1), as already mentioned: this condition is almost never realized. The analysis was made by the elastic theory as is used on reinforced concrete arches. The method is explained in Furneaure and Maurer's "Reinforced Concrete Construction." The loads on the right are the dead loads, while those on the left are the resultants of the dead and wind loads at each load point. The thrust, shear, bending moment, and eccentric distance at the crown were calculated and the equilibrium polygon and force diagram drawn. To insure accuracy the bending moment and eccentric distance were also calculated at each load point and checked with the graphics. At the spring line on the leeward side the stress due to both bending moment and direct thrust is a maximum, being 5262 + 78 = 5340 pounds per square inch. This is about the ultimate strength of fir.

One half of the force diagram for the hay load is shown by dotted lines. The stresses caused by it are small in comparison to the wind load.

The second condition, the three-hinge arch: This is the condition usually existing in Gothic roofs, the joints at the plates and peak not being rigid. Values for the horizontal thrust and the shear at the crown were calculated by moments. Then the equilibrium polygon and force diagram were drawn. The force diagram naturally passes through the three hinges since the hinges offer no resistance to bending. The maximum moment is at point 4, left. The maximum stress is also there, being 7158 + 18 = 7176 pounds per square inch. This is above the breaking point for ordinary



Gothic rafter considered as a continuous arch with fixed ends, spaced twenty-four inches apart



Gothic rafter considered as a three-hinge arch with pivot points at peak and plates

lumber. In this case also the hay load is small compared to the wind load.

It is, therefore, evident that a bent rafter made of five pieces of one-by-fours will not stand up under a wind load of thirty pounds per square foot. This is particularly true when it is remembered that the separate pieces cannot be expected to act as a unit when made in the usual manner. There are also splices which weaken the rafter. Further analysis by the three-hinge-arch method shows that a rafter made of eight pieces of one-by-fours (actual size 3¾ by 6½ inches) would be about right for a wind pressure of fifteen pounds per square foot, provided it would act as a unit, and provided the splices in pieces near the outsides were made near the ends rather than near the middle of the rafter where the stress is the greatest.

The strength of the sawed rafter cannot, in my opinion, be computed with accuracy. We will probably have no definite idea of its strength until actual tests are made under loads which are applied like wind pressure.

I realize that this is painting a dark picture of the Gothic roof. It will be of interest, therefore, to see how it compares with other types of construction.

STRENGTH OF JOINTS LIMITING FACTOR

The report of the 1918 annual meeting of this Society contains an analysis by Mr. Strahan of the Shawver frame which is usually considered the strongest of all self-supporting barn roofs. His analysis assumed a heavy wind load (40 pounds per square foot) and the truss taken was quite high. Compression was indicated by the minus sign (—) and tension by the plus sign (+). I have checked over this analysis and find it correct if the Shawver frame would act as a real truss. Mr. Strahan pointed out, however, that the Shawver frame is not a truss at all unless the lower rafters are designed to carry tension. He suggested that a 1½-inch rod be provided to assist them in this respect. But if such a tension member should be provided then the truss in question would fail at the joints long before the wind pressure reached 40 pounds per square foot. The joints would fail because it is impossible to put enough bolts or nails in them to carry the calculated stresses. For example, the purlin post on the windward side has 36,100 pounds tension. For safe design this requires about thirty-six ¾-inch bolts or one hundred and twenty 40^{d} nails at each end. Plainly any such number is out of the question. Any structural engineer will say that in a truss having wood tension members the strength is limited by the joints. Often it is not practical to use a joint which will develop more than one-eighth or one-fourth of the full strength of the timbers.

The report of the 1916 annual meeting of this Society also contains an analysis of the Shawver considered as a real truss. The wind load was thirty pounds per square foot. In these calculations the shear at the crown was neglected. The reaction at the crown should have been at an angle instead of horizontal, giving a horizontal component of 4950 pounds and a vertical component or shear of 6400 pounds. When this correction is made the stresses are entirely changed. Some are increased while others are reversed. The stress in the windward peak post, KJ, becomes 19,250 pounds tension. This might require seventy-seven 20^{d} nails where this member is fastened to the collar beam.

I am convinced that the Shawver frame as usually made will not act as a real truss and, therefore, this method of analysis does not represent the truth. Most of its strength is due to its resistance to bending. The joints are a vital part of the construction, yet I cannot recall ever having seen a plan which specified exactly how many nails or bolts should be used. We have been neglecting our plain duty as engineers because we have left the most important part of the construction to the judgment of the carpenter. Information on the lateral strength of nailed and bolted joints may be secured from the following references:

"Engineering News," Vol. 76, page 115

Iowa Engineering Experiment Station, Vol. IV, No. 2

"Structural Details, Design of Heavy Framing," Jacoby

"Practical Structural Design" McCullough

Doubtless most of us consider the wing-joist or braced-rafter type of roof as the least substantial. At least it is weaker than the Shawver. Its strength cannot be calculated exactly. By comparison with the Gothic, however, we can be sure that the lower rafter on the windward side would break near its center long before the wind reaches ninety miles per hour since there is only a single two-by-six at this point.

I regret that so far my work seems largely destructive. I expect to follow it up with more constructive work. At the present time I have come to five conclusions as a basis for further work:

1. We know practically nothing definitely of the strength of ordinary barn roofs. Most of our knowledge may be summed up by saying that many have been built and comparatively few have fallen down. This is no more than carpenters know. Careful analysis shows that none of the common styles will stand up against a wind of ninety miles per hour or a pressure of thirty pounds per square foot.

2. It is not necessary or desirable to provide for any such wind load. Such winds may occur only once in a generation. Furthermore, the ordinary barn frame would not stand such winds even if the roof could. Since little consideration of human safety is involved we ought to come to a more reasonable basis and then make our designs safe in the joints as well as otherwise for the revised loading.

3. The Gothic roof with bent rafters and also the braced rafter need to be strengthened considerably to stand safely a wind of fifty to sixty-five miles per hour or a pressure of about ten to fifteen pounds per square foot.

4. The Shawver frame is not a real truss and should not be analyzed as such. One reason for this has already been given. Another reason is because the purlin is not fastened securely enough to the post to transmit much compression from the lower rafter to it.

5. There is an urgent need for tests to determine the strength of the Shawver and the braced-rafter styles, also to see how well the Gothic bent rafter will act as a unit. Until such tests are made we can only guess at their design and their strength. Probably our guess will be no more intelligent than a carpenter's guess. In such tests the wind loads should be applied perpendicularly to the surface as they actually occur.

EDITOR'S NOTE: Since the foregoing was presented, at the last annual meeting of the Society, Mr. Clyde has designed a new type of truss which he believes can be treated as a real truss. It is described in the March, 1922, issue of "American Builder," together with some further discussion of the Shawver frame. A model of the new truss was tested at Iowa State College on February 27, 1922, and its strength found to be fully up to expectations. Plans are being made for similar tests on the familiar types of roofs.

Corn Picker-Husker

INVESTIGATIONS of the corn picker-huskers in use has led the agricultural engineering section of the Iowa agricultural experiment station to the conclusion that the machines of standard makes are giving good service when they are properly adjusted. The most important adjustment is the pressure on the snapping rolls. These must be adjusted to suit the moisture conditions of the field. Too much pressure will break up the stalks badly and tend to clog the machine with broken stalks. If the pressure on the snapping rolls is too light, there is a tendency to crush the butts of the ears and shell considerable corn. It would seem desirable to have the field fenced hog-tight in order to utilize the five or ten per cent of corn which is shelled or missed by the picker.

New Engineering Developments in Land Clearing*

By John Swenehart

Mem. A.S.A.E. Associate Professor of Agricultural Engineering in charge of land clearing, University of Wisconsin

CONDITIONS have changed materially in the development of land clearing in the Great Lakes states. In 1915 Wisconsin started with one man devoting his entire time to land clearing problems. This was the first directed effort by state or federal government. In the three lakes states, Minnesota, Wisconsin, and Michigan, we now have sixteen men putting in their entire time to land clearing. Positions are now open in Wisconsin alone for three more land clearing men. Why the increase?

First, undoubtedly there has been directed towards the land clearing problem the attention of trained men who honestly recognize the possibilities in cut-over regions. In the past few years land values have changed, not the result of a boom as in the great agricultural states, but rather the steady and conservative rise in the value of land due to its increase in productiveness. In other words, today the value of raw cut-over land in the Great Lakes states plus the ordinary cost of clearing is less than the actual value of the land when cleared. Nearness to markets, adequate railway transportation, and on an ocean waterway in the very near future are considerations which should lead engineers to study the immediate reclamation of these lands. Since 1910 between thirty and thirty-five thousand farmers have come to northern Minnesota, Wisconsin, and Michigan, where they are rapidly converting labor into improved farms. A total of over 100,000 farms are now on cut-over land in these three states.

Land clearing is the limiting factor in the agricultural prosperity of the region. Dairy production which at the present time has not been carried on to a point of low returns, is the type of farming for which the region is adapted. The number of livestock today in the various counties of upper Michigan, Minnesota, and Wisconsin is such that the natural increase in this must be cared for by either buying expensive feed or clearing land. The ordinary rate of clearing is not sufficient to meet the demands.

RAPID CLEARING TO DEFEAT INTEREST COSTS

It is doubtful whether government aid can ever be expected to help the man who starts with little or no capital and practically no equity in the land. Financial aid in a business way depends on the productive possibilities of the land. A big phase of the engineering problem of reclamation in these sections is immediately to develop the land to a point where it can be collateral for a loan. Raw cut-over land anywhere is not sound collateral unless it is a part of a farm having considerable improved land. The Federal Land Bank system says that cut-over land has loan value only when there are at least ten acres of land fully cleared on the farm. Banks generally are of a similar opinion. Therefore, the problem today in Wisconsin, Minnesota, and Michigan, and in other cut-over sections, is to get the land to a point where it can produce and where it can be collateral for a loan without outside help. Perhaps greater and quicker financial arrangements can be made through a colonization company. However, colonization companies with independent capital really interested in development are few and far between. Most of the thirty thousand new farms in the lake states must bear their financial burdens. The solution is clearing, rapidly pushed to a point where the new farm will pay interest on investment, a living to the farmer and prospect for paying principal debt. The ordinary rate of one acre cleared per farm annually will not do this. Financial bankruptcy will almost surely follow agricultural conditions today unless clearing is speeded up.

Three aspects of the land clearing reclamation project seem of particular interest to the agricultural engineer: First, promotion work; second, mechanical engineering work; and third, the training of men capable of carrying on one or more of these phases of the work.

The first task of the land clearing engineer is to sell his idea to the people who have land to clear and who are to be benefited by land clearing work. This involves sale of the project to not only farmers and prospective farmers but to bankers and financial interests who must be sold in order to furnish the money to back the enterprise, and to the public generally so as to create enthusiasm and interest in the project.

LAND CLEARING ASSOCIATIONS AND ENGINEERS

The land clearing engineer today can place before a banker or financial interest, before the farmer, or before any business man or organization, an array of facts which proves that land clearing is of importance to every member of such a community. The farmer has definite money returns figured in increased land values and in crops raised. The banker has increased collateral, therefore increased business. More production means more money and more business for everybody, and better living.

Realizing that the rate of clearing in the past has been too slow for sound development, a plan has been worked out which stimulates and promotes land clearing, and gives a definite opportunity for engineering assistance. The plan is to organize a cooperative land clearing association composed of farmers, bankers, business men, press, college and other state agencies, manufacturers of explosives and machinery, and all business interests which can be enlisted in the cause of more cleared land. It is necessarily not a farmers organization because it must have the support of other members of the association who are largely if not equally interested with the farmer. A representative organization is worked out with a membership in all parts of the district or county and with a central committee representing the various units of this district. This central committee or board of directors employs a business manager land clearing engineer particularly qualified to carry out such a project. A definite quota is decided on in terms of acres to be cleared and based on the needs and possibilities of the district. This man is a full time land clearer having charge of the association, planning distribution of materials, creating enthusiasm for land clearing, and supervising demonstrations and instruction so as to make the materials cover the largest

*Paper presented at the fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27, 28, 29, 1921.

possible area. His is the clearing house for land clearing work of all kinds, sale or rent of machinery, contractors, publicity, etc. He is the driving engineer to get a definite quota of land cleared in the county within the assigned period. Details of his particular job and the whole scheme can be worked out. In connection with distribution of materials, the associations saved from $15,000 to $20,000 each last year in addition to other work. This plan was first successfully carried out under the direction of L. F. Livingston, in Marinette County, Wisconsin.

The big feature is that there is definite need today for a land clearing engineer in charge of land clearing reclamation in counties or equivalent districts in the cut-over area. He has labor, he has finance, he has good land. It is for him to harness and drive the team.

The mechanical engineering phase of land clearing has to date been only touched. The present margin between the value of raw and cleared land is such that wholesale clearing seems much nearer than it used to be. In addition, interests and taxes are forcing the big nonresident land owner to get busy. It seems that some method will be developed to clear or provide for clearing a part of the land on every farm and thus hasten settlement.

It should be here pointed out that it will be several years before these cut-over farms can be a factor in production. By that time agricultural price conditions should become adjusted and apparent overproduction avoided.

Many social and economic questions are involved in such a program, but the financial conditions seem to be pushing toward larger land clearing operations for the first few years at least on the new farm.

MEASURING THE DRAFT OF STUMPS

Stump removing machinery in the past has been developed very largely by guess work. Nobody seemed to know just what strength or speed would be needed. As a result, we have machines being made strong enough to give five or ten times as heavy a pull as is needed. These machines either must be very heavy or they must be very slow. Tests were made in Wisconsin the past year to work out the relation between the speed of pull and the pounds of pull as well as the probable strength of ordinary materials. We have long known that it was easy to use a horse power puller of the capstan type and pull a stump so large that it could not be handled after it had been removed. A team is the most common unit of power for skidding, dragging, and other work on farms in the cut-over district. Therefore, it was deemed desirable to base our work on a unit equivalent to the work which could be performed with a farm team. While these investigations are not complete, some interesting facts have been brought out.

Trials were made largely on white pine stumps in different kinds of soil, varying from sandy soil to superior red clay. The pull required, of course, varied with the size of the stump, its age, kind of soil, and many other conditions. It seemed absolutely essential at the outset to use sufficient dynamite to split the stump so that the pieces could be handled when they were finally pulled. For making the pulls a 5,000-pound dynamometer was equipped with a set of levers to permit measuring the high pulls. Three-quarter-inch cable was used in all tests. Larger sized cables are heavy and unwieldy to handle and much less flexible for use on drums in pulling. The pulls on stumps (two feet in diameter and over) ranged from a little over 10,000 pounds to 24,000 or 25,000 pounds.

SKIDDING AND PILING BY MACHINE

Pulls of 25,000 pounds break ordinary three-quarter-inch cable which had been used but a short time on the machine. Stumps which required a pull of 20,000 to 25,000 pounds, were so large that it was very difficult and impractical to handle them afterwards. Pulls up to 18,000 to 20,000 pounds can be safely made with the three-quarter-inch cable. It should be noted that the manufacturers list the breaking strength of standard plow steel cable (six strands of nineteen wires around a hemp center) as 23 tons. This figure is, of course, based on the cable when it is new. They also indicate a working load of approximately 20 per cent. From the trials, it is observed that 30 to 40 per cent of the breaking strength can be considered a fair load in stump puller work where the speed is slow. Statements by stump puller makers claiming enormous pulling power seem entirely untrue.

There is no doubt that larger sized cable and larger equipment throughout could be provided to pull any stump, but in view of the fact that the majority of conditions require pulls ranging from 10,000 to 18,000 pounds, it would hardly be desirable to have larger machines and equipment when it could not be used at full capacity very much of the time. In the design of machinery a maximum pull of perhaps 15,000 to 18,000 pounds seems desirable under Wisconsin and lake states conditions. In the skidding and piling operations trials showed that a maximum pull of approximately 2500 pounds would be desirable which also means that the skidding line could have eight to ten times the speed of a pulling line, using the same power equipment. Speed and flexibility in skidding and piling operations are the essential of all around land clearing equipment. For an occasional heavy pull, either with the skidding line or with the pulling line, a

Tractor used in connection with winch for pulling trees down and roots out prior to dredging operations

pulley could be used and very nearly double the pull. This is a much cheaper method than to devise the machine at the outset with a sufficient strength to make the big pulls direct.

Several power machines have recently been developed, each perhaps having some particular advantages. The Southworth machine, designed by P. D. Southworth, Chippewa Falls, Wisconsin, is probably the most promising development along this line. It is designed more for skidding and piling but handles light pulls to advantage. This machine has a LeRoi 15 horsepower, four-cylinder gasoline engine as the power unit. A transmission constructed as a unit with the engine reduces the engine's speed of 1200 revolutions per minute to 300 revolutions per minute, and this is transmitted through chain drive and gear reduction to get a speed of approximately 30 to 35 feet per minute on low gear with the main pulling drum. This gives a pull of approximately 12,000 pounds maximum pull by dynamometer test. A high gear on the same drum gives a speed of 166 feet per minute and a pull of about 2,000 pounds. Field tests with this machine in which a dynamometer was hooked into the line, show that the high gear should have a little greater pull as well as a little greater speed, which means better design and slightly larger engine than the 15 horsepower now used. A 20 horsepower engine could give a speed of 200 feet per minute on a pull of 2500 pounds. For the low gear a pull of 12,000 pounds seems to be sufficient and a speed of 30 to 35 feet per minute can be easily maintained. This machine was designed with a view to skidding and piling rather than for pulling, it being realized that to get a machine large enough for pulling required greater weight, larger power units, greater expense, all of which would not be used much of the time.

PULLING NOT SO IMPORTANT AS PILING

It was felt that explosives would better be used in advance of pulling and reduce the size of the equipment all around. This machine is also equipped with a drum to be used for piling. The piling boom or derrick remains stationary in height but can be swung from side to side. The piling drum operates a cable passing through a pulley at the upper end of the boom. On its outer end this cable is fitted with power pulley through which the main pull line passes. This power pulley is permitted to hang free from the end of the boom nearly to the ground. When the stump is pulled and drawn up to the machine, then the piling drum is set in motion, raising the stump to the top of the boom and on to the pile. A third drum is used as an out-haul. At the present time this drum is speeded the same as the high gear on the main line drum, approximately 166 per minute. However, it is intended to increase the speed of the out-haul as this does not have to do any particular work and time will be saved by a fast movement. Perhaps 300 feet per minute can be made with this out-haul and still have plenty of strength to handle the cable.

The Rabey stump puller and piler built by W. W. Rabey, of Hill City, Minnesota, is a two drum machine, using a 12-25 Avery tractor engine. The particular feature of this machine is the friction drive with a 24-inch friction disk keyed to the crankshaft of the engine and a 24-inch friction wheel set on the shaft at right angles and driving the gears which in turn drive the drums. Actual tests of the pulls are not available on this machine. It is steel built and mounted on a wheel base which is geared to the engine to provide traction. A ground speed of one and one-half miles per hour may be maintained. The hoisting line is listed as having a speed of 440 feet per minute. The pulling drum has a speed of 20 to 600 feet per minute.

Public demonstrations of large numbers of stumps pulled in an hour and in a day have been made with these machines but such demonstrations under favorable conditions mean nothing to the land clearing engineer. Both of these outfits, however, do recognize the fact that piling is the most important part of the land clearing job. Both are designed lighter with a view to moving from place to place.

The Bissell stump puller is designed to use a large steam engine on a caterpillar tractor base with two drums, one pulling from each side. No anchor is used, the stumps on one side being pulled serve to anchor for the pulling on the opposite side. Stumps are dragged into a windrow occupying about 20 to 30 per cent of the land. No piling is done. The machine weighs approximately 55,000 pounds according to advertised specifications. One and one-eighth-inch main line cable is used. No haul-back is specified, a horse being used for this purpose. The caterpillar tractor base permits the pulling direct from the rear of the machine. The ground speed is approximately one mile per hour. While there is, of course, no question but what this machine will pull stumps rapidly, it does not take into consideration the matter of piling, which as a rule consumes the larger proportion of land clearing cost. The large cost of the machine and its construction eliminates it from consideration by the man of small means. Even the small contractor cannot hope to have the equipment which such an outfit would entail. Several other machines have been constructed but do not seem to have the promise of the machines first mentioned. As far as pulling alone goes, a horse power machine is generally superior. Skidding and piling are the big items in stumping cost.

Each year brings many other new machines and methods into the land clearing game. Among these might be mentioned the Crockston brush mower which is a large tractor-operated device for the cutting of brush where stumps are not in the way.

The usual number of burning stunts have developed with various drums and ovens suggested for char-burning the stump. Chemicals have again been suggested to hasten the decay of stumps. None of these latter schemes seem to have much practical value to commend them. It is hoped that with definite information as to the requirements, that engineering skill can be combined with land clearing field knowledge to a point where power can be economically applied to clear land.

DISPOSING OF BRUSH BY PLOWING UNDER

Some portions of the cut-over districts, particularly in Minnesota, Michigan, and Wisconsin, there are areas of considerable extent having very few stumps to the acre and where the brush has not grown very large on account of fire or other conditions. In these districts plowing outfits are being devised to turn under brush, even as large as 3 inches in diameter. Investigations are being made as to the practicability of such a plan. The effect of the method on the soil and the effect on the settler who has his work done for him are questions to be investigated as well as those of strictly mechanical nature. Obviously to plow down large brush requires a considerable sized tractor and a plow having very large clearance. Frank Conrath, of Conrath, Wisconsin, living in a district adaptable to this method, used a 15-27 tractor with an Oliver brush breaker but found that the throat room between the beam and the land was not sufficient to permit the plow to keep clean. The brush would accumulate and throw the plow out of the ground. To obviate this difficulty, he selected a peculiarly shaped tree and hewed out a special beam which increased the clearance from about 16 inches to 25 inches. This was found to increase materially the effectiveness of the outfit. Large plow manufacturing concerns have designed plows having very much more clearance and designed more particularly for marsh and cut-over work. These plows have been 20 to 24-inch cut.

Undoubtedly, the development of brush plowing has only begun in those districts where the plan is adaptable. Work of this kind has been done also in Minnesota where a very large area bordering the prairie section is particularly adapted to the method, having few stumps and comparatively light brush. The question of using large power units, consisting of several teams of horses, is being considered and a later report will be made of the results of this investigation. One of the big needs in connection with land clearing work is to speed up the clearing, at least on the first ten acres. This means that plowing of the land, whether the brush is still standing or whether the brush has just been cut, is done under difficulties on account of the many fine green roots. Plowing on a large scale, however, requires big equipment entirely out of the reach of the ordinary farmer. Therefore, it is only a contractors equipment or perhaps the equipment for a colonization company who are particularly interested in the sale of their mortgaged indebtedness on the land. Where a colonization company or a contractor is available and where the natural land conditions are such that few stumps exist, brush plowing can be very economically carried on. In this connection, it is important to note that the large plows are very much more effective on stony land than the ordinary small plows with a small two horse team. On the other hand, consideration must be given to the fact that the settler desires to market as much labor as possible in the clearing of his own farm.

SELLING THE LAND CLEARING IDEA

The most advanced demonstrational idea is the traveling land clearing schools of Marinette County conducted by the Marinette County Land Clearing Association in 1921. In this work trucks were used to transport stump pullers, pilers, and complete blasting outfits. The trucks carried a crew of experienced men who acted as instructors. They visited thirty-three communities in Marinette County during May and June. In each place, not less than ten farmers signed up and agreed to spend the day with the land clearing school, actually working under the direction of the demonstrator instructors, using the tools and equipment carried by the land clearing association with the cooperation of manufacturers of land clearing equipment, business men, and the Wisconsin college of agriculture. The idea of taking the work to the immediate community is its claim for effectiveness.

The land clearing school idea is now the most important form of demonstration in Wisconsin. The fundamental idea in this method is to get the farmer actually working with the demonstrator instructors rather than having him stand to one side and watch the other fellow do it. It is not quite so spectacular but much more productive of good in the community.

The Minnesota Land Clearing Fleet, a new demonstration idea, was operated in the fall of 1921. Take the show to the people is the big idea. This consisted of complete land clearing equipment, pilers, pullers, explosives, and cut-over land tillage implements. These were carried from place to place on trucks by means of motor trucks giving daily demonstrations to crowds of farmers, bankers, and business men interested in the development of Minnesota's cut-over land.

War salvaged explosives perhaps should not occupy a very large portion of our time in this discussion, but inasmuch as there are many million pounds of picric acid yet available to farmers of the various states, it is fitting that a few words be said about it. Investigations were conducted by the Wisconsin college of agriculture in cooperation with the U. S. Bureau of Mines and the U. S. Department of Agriculture to devise methods of packing and use of war-salvaged picric acid. This involved the preparation of the picric acid, drying and cartridging it, and it was found that 2 per cent moisture permitted this operation to be carried on economically. Wet picric acid as it stored, being unexplodable and dry picric acid being so dusty that it could not be satisfactorily cartridged. Two per cent water allays the dust but does not kill the explosive. Picric acid, while shattering in its effect, was found to be entirely usable, its strength being about one-third to one-half greater than ordinary dynamite. It is worth, in terms of dynamite, approximately 20 to 23 cents per pound, dynamite selling at approximately 15 to 18 cents per pound.

Picric acid is entirely unaffected by temperature changes which are ordinarily encountered. It is not a liquid and, therefore, does not freeze. In handling, in land clearing operations, no poisonous effect could be noticed; in fact, its use as a medicinal agent in connection with burns indicates that the material is not poisonous to the human body. The gases given off on explosions, while containing considerable quantities of carbon monoxide, are easily avoided in land clearing operations. Altogether the picric acid is a desirable explosive when it can be secured from salvaged surplus. It cannot be manufactured at the present time to compete with commercial explosives. It is not a material which should be used as a basis for a campaign because the effect will not be permanent and while we may be able to get "a flash in the pan" by using a limited quantity of war explosives, we will not get permanent results if this is the basis of a campaign. Therefore, in Wisconsin we are basing our campaigns on the use of a commercial explosive, unlimited in quantity and desirable from the standpoint of the particular needs of land clearing which desirable qualities are, first, a slow heaving dynamite; second, a dynamite cheap to manufacture; and third, a dynamite effective to use and as near foolproof as possible.

Obviously to carry out the program suggested requires experienced land clearing engineers. Their experience must be gained in the field. Developments of new farms from cut-over lands is coming in other states as well as the lake states. Many areas have land which permits purchase and improvement at a profit based on sale and loan values. This means not production to swell an apparent present surplus of wheat and other produce. It means homemaking first and production later when it will be needed at fair prices.

Soldering Aluminum

IN CONNECTION with experiments in soldering aluminum at the California agricultural experiment station, A. H. Hoffman reports that ordinary "half-and-half" lead-tin solder may be made to adhere fairly satisfactorily to aluminum by adopting the following procedure:

1. Scrape the surface clean with a sharp, smooth-edge knife or scraper.
2. Apply ordinary noncorrosive soldering flux.
3. Warm until the flux melts and covers the clean part.
4. Rescrape thoroughly while surface is warm and covered with flux.
5. Wipe off the scrapings but leave a film of flux on the surface.
6. Apply fresh flux.
7. Apply solder with a clean well-tinned soldering copper at the right temperature, not too hot.

The proper temperatures for soldering aluminum can be learned readily by experiment. It is found that good adhesion is secured much more readily if the part can be covered with a pool of melted (not burning) flux. Rubbing the aluminum under the flux with a clean well-tinned copper will facilitate adhesion. The flux apparently does not remove oxide from the surface of the aluminum, but merely prevents access of the air to the surface. The oxide must be removed by mechanical means while the surface remains insulated from the air by the flux.

Report on Left Hand Plow Investigation*

THE first step we attempted in this investigation was the locating of the left-hand plow territory; and the first step was a questionnaire to the plow manufacturers. The second step was the conducting of an investigation among manufacturers, dealers, county agents, farmers, etc., as to why the left-hand plow was preferred, and to determine if the general situation would be benefited by the complete elimination of the left-hand plow.

We have gotten as far as the county agent this year. We have a compilation of something like five hundred different counties in seven different states, and we feel that according to the general law of averages the preliminary conclusions drawn from these results will be fairly accurate.

The first questionnaire was sent out to thirty-three manufacturers building left-hand plows and we received thirty-one replies.

We divided it into three major questions. In the first question it was asked if they manufactured left-hand plows. If so, whether they manufactured walking plows; also riding plows, which included sulky and gang.

To the first question, as to whether or not they manufactured left-hand plows, 70.9 per cent replied that they did, and 29.1 per cent replied that they did not. So there is a large number of the companies still manufacturing the left-hand plow, even though it was eliminated during the war and later reinstated.

The walking plow seems to be the thorn in the flesh; in connection with that situation, 95.4 per cent manufactured walking plows while only 4.6 per cent of that number manufactured riding plows, which included gangs and sulkies.

Only 59.09 per cent manufactured riding plows, while the balance did not manufacture riding plows in left-hand molds. It can be readily seen then that the big problem is with the walking plow, and that is practically confined to Indiana, Ohio, and Pennslyvania. There is where the problem I believe will have to be attacked the hardest.

We also have some very interesting figures that were obtained from a federal government report on the statistics of the number of plow molds laid down in 1920. The total number laid down in that year by all plow manufacturers in the United States were 820,259. Of this number of molds 801-993 were right hand and only 18,266 were left hand.

On a percentage basis, only 2.2 per cent of the total number of molds laid down are left hand. Therefore, the left-hand plow is indeed in the minority as to the number being manufactured. It was rather interesting in going through those letters and questionnaires to find some of the statements made by the manufacturers. There was no general opposition to the elimination of the left-hand plow with the exception of three companies, and they were rather outspoken.

One company, of which I happened to know some of the officials and which is an Ohio firm, said they would continue to manufacture left-hand plows no matter what the manufacturers' association recommended.

One of the Michigan companies said they were entirely opposed to the elimination of the left-hand plow. Upon investigation I find they are manufacturing left-hand molds only.

And another company said they had participated in several of these discussions and had never gotten anywhere, and, therefore, they did not want to go on record as entering another discussion on the left-hand plow situation.

As to the distribution of the left-hand plow territory, I am giving this on a percentage basis, which I think is more comprehensive. Taking the manufacturers as a whole, 80.9 per cent reported Indiana as a big left-hand plow territory; Ohio, 71 per cent; Pennslyvania, 33 per cent; Kentucky, 47 per cent; Tennessee, 42 per cent; Illinois, 42 per cent; and so on down the line, including North Carolina, New York, Michigan, West Virginia, Delaware, and New Jersey, some of Kansas, and some of Missouri.

The county agents gave us some valuable information. We have about four hundred and fifty questionnaires answered by them and I place a lot of faith in their answers for the reason that the majority of the county agents in Ohio waited to answer the questionnaire until after they had had a meeting with their farm bureau, so you can see that their answers are not alone their opinions but also the opinions of the executive boards of the farm bureaus.

Indiana's report was based on manufacturers' figures which showed that 38 per cent of the total number of bottoms are left hand.

MR. DICKERSON: You said that 80.9 per cent of the manufacturers reported Indiana as the big territory.

PROF. MCCUEN: That is, 80.9 per cent of the thirty-three manufacturers reported that Indiana was their best left-hand plow territory. I knew these figures would be more or less confusing if I did not make that point clear because the sum total would be more than one hundred per cent. Indiana's report I have said is based upon manufacturers' figures.

Ohio's report was based on reports of 59 out of 89 county agents; 30.6 per cent of the counties do not use the left-hand plow extensively, and 38.9 per cent do use them extensively.

Comparing the figures (percentage using left-hand plows) for the two states, Indiana's is based on the manufacturers' figures and is 38 per cent; Ohio's data is based on county agent figures, substantiated by the Farm Bureau, and is 38.9 per cent. There is 0.9 per cent difference between the two states, based on two different methods of inquiry.

In Pennsylvania 27.4 per cent do not use the left-hand plow at all. Pennslyvania is one of the largest states which we have to deal with. Also 8.4 per cent do not use left-hand plows extensively, while 40 per cent do use them extensively.

Here we have three states bordering, in which 38, 38.9 and 40 per cent of the states respectively use left-hand plows. That is based on the data we have at hand.

New York reported 45 counties, all in the negative, that is, left-hand plows are not used extensively. There are certain localities in which left-hand plows are used, but not to any extent.

Kentucky reported 38 out of 62 counties, or 61.2 per cent reporting; 42 per cent reported left-hand plows used extensively, and 57 per cent not extensively.

In Michigan, out of 52 counties reporting, only one reported that left-hand plows are used extensively.

So the left-hand plow territory is practically confined to Kentucky, Ohio, Indiana, and Pennslyvania, in which the percentage of counties using them ranges from 38 to 42 per cent.

The next phase of this investigation we propose to take up, inasmuch as we have the left-hand plow territory well located, is to get some definite information as to the viewpoint of the dealers. We asked the county agents to give us a list of three or four prominent dealers in each county. We wanted well-established dealers, men who had been in business a considerable length of time because they understand the situation better than anyone else; also we wanted these

*Presented at the fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27, 28, and 29, 1921.

dealers widely distributed in the county so there would not be three in the same town. We have a list of between 1400 and 1600 dealers, to which we will send questionnaires.

Following the dealers, we are going to the farmers through the agricultural college extension workers in a house-to-house canvass. Whenever an extension worker is on a project of some sort we will make it a point to get all the information we can on the plow situation in that particular locality.

The important phase of the work will be the education of farmers to the use of a standard moldboard, a right-hand moldboard.

The whole problem is largely a question of psychology. They say that after horses are once broken to the left-hand plow it would be a hard matter to change them to right-hand plowing. I do not believe it. At Indianapolis a demonstration of that sort was made. One of the leading plow manufacturers told us how he took a plow out to a farmer near that city and said: "We would like to have you try this plow out for us." He looked at it and said: "That is one of those damned right-hand plows; I cannot make my horses work on it." However, inside of half an hour, after he had made a few changes in his reins and hitching and in the adjustments, the horses went off as if nothing had been changed. So it seems to be purely a psychological question with the majority of the farmers.

COMMITTEE ON LEFT-HAND PLOW INVESTIGATION

G. W. McCuen, Chairman — C. I. Gunness
Wm. Aitkenhead — R. U. Blasingame

DISCUSSION

PRES. WHITE: Understand, gentlemen, that these are purely preliminary reports, given primarily for the purpose of getting these problems before the members of the Society. We would like to have some discussion on this question.

PROF. GROSS: I want to ask Prof. McCuen whether the investigation took into consideration and provided for any data on two-way plows made with two bottoms, one right-hand and one left-hand, used in the irrigated sections chiefly.

PROF. MCCUEN: We found that to be particularly true in New York and in some of the terraced regions in southern Ohio. Manufacturers would have to continue building the two-way plow, because the user could not turn the plow down or up, as the case might be, satisfactorily and do a good job of plowing. That will have to be an exception I believe; in fact, I know its manufacture will have to be continued because there are certain sections that will necessitate that type of plow. As a matter of fact, they are not interested in those sections in right and left-hand plows because they use both of them. They have to have that particular type of plow there to meet their particular conditions.

PROF. GUNNESS: The eastern farmers, a good many of them at least, demand the two-way plow. I have been told that is one of the objections that every tractor salesman meets in the small farm regions; he cannot sell a tractor plow that works both ways. That is a much more serious proposition for the salesman of the small tractor than you might suppose.

PROF. DUFFEE: I was born and raised with a left-hand plow and went through the transition from a left-hand to a right-hand plow. When this question of the elimination of the left-hand plow came up some time ago, I happened to be visiting one of my uncles. I made it a point to ask him about it—he is a very progressive farmer, and has a tractor. I said, "What do you think about the right-hand plow?" "Well," he said, "it is just as good, there is no question about that. It is just a matter of getting used to it, and if it is economy for the manufacturers to manufacture it, let them go to it." I wanted to add that to the discussion from a practical farmer.

Discussion on Sunshine Efficiency of Hog Houses

EDITOR'S NOTE: This discussion followed the presentation of the paper, "Sunshine Efficiency of Hog Houses," by F. C. Harris, at the fifteenth annual meeting of the American Society of Agricultural Engineers, Chicago, December 27, 28, and 29, 1921. Mr. Harris' paper was published in the November, 1921, issue.

MR. KING: It is a mistaken conception that the sun's rays passing through glass have a disinfectant power actually to kill germs. Two years ago I had occasion to take that matter up with a number of the leading bacteriologists of the country and they assured me that sunlight after passing through glass has practically no disinfectant power and that it has lost its violet rays. Its main efficiency in that case is to keep the floor dry and prevent development of germs.

I want to second a thought brought out here that in the design of a hog house we want to consider other features than that of a window, and one of those of special importance is the amount of cubic volume that must be heated by the hogs' bodies as affected by the design of the house. We want to keep that cubic volume as low as possible.

PRES. WHITE: The Society is very much indebted to Mr. Harris and the company which he represents for this exhaustive study, on one phase only remember, of the design of hog houses. I hope you men realize that it is work like this that is putting the foundation under the profession of agricultural engineering. I also believe that this discussion of Mr. Harris' will enable some of us to read this paper which has already appeared in the November number of the Journal with more intelligence.

MR. STEWART: There are a few things we may go astray on. Do we need sunlight to kill the germs or for heating purposes, or just plain sunlight, or all three? From the standpoint of killing the germs, the germ-killing power of sunlight is due mostly to the ultra-violet rays of light which are quite largely intercepted by the glass. Those that do go through the glass are so thoroughly scattered inside of the building that no greater percentage of those rays strike where the sunlight does than strike the rest of the building. If we were to take a picture in that building with a camera, in which we used a screen so as to cut out all light except the ultra-violet rays, you could not detect any sunshine shadow. The ultra-violet light would come from all parts of the building with equal luminosity, showing they are entirely scattered.

So far as the killing power of the sun's rays is concerned, the sunshine pattern has very little to do with it, and it is only the amount of square feet of glass surface perpendicular to the sun's rays.

If we are talking about the amount of heat secured from sunshine, then again the amount of surface the light strikes upon will have nothing to do with the amount of energy received from the sun, but it is only the total square feet of sun's rays measured in a cross section perpendicular to those sun's rays that get within the building, regardless of whether it covers five square feet on the ground or whether it covers only one square foot.

Then, from the efficiency standpoint, we must also consider that the sun's rays in the morning only have a heating efficiency, at nine o'clock about sixty per cent of that at noon, measured in a perpendicular cross section of the rays of light, due to a greater absorption of the atmosphere which the sun's light has to come through.

In addition to that I would say that the use of the term "efficiency" here seems to me a rather unsatisfactory term to use for energy. We have a very definite meaning for the word "efficiency." I believe the proper term to use here would be the word "coefficient." If we want to discuss it as the coefficient of sunshine rather than efficiency, it can be worked out on the basis of efficiency, but then we would need to consider, for instance, in the case of where we had forty square feet of glass area, and an efficiency of one to four, that would mean we would get 160 square feet on the floor.

Agricultural Engineering Development

A Review of the Activities and Recent Progress in the Field of Agricultural Engineering Investigation, Experimentation and Research

Edited by R. W. Trullinger

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USE OF POISON IN MAINTENANCE WORK ON DRAINAGE CANALS, O. C. Kulicka, [*Engineering News-Record,* 87(1921) No. 8, pp. 322, 323.] Experiments on the prevention of stump sprouting in the drainage channels of the Riverside and Bogue Phalia drainage districts in Mississippi indicated that the most effective treatment consisted of cutting the trees and bushes in the channels about 6 inches from the ground surface and poisoning the stumps with a preparation of granulated caustic soda and white arsenic. In a suitable vessel containing 8 gallons of water 10 pounds of caustic soda are poured, and as soon as the water begins to steam from its action upon the soda, 10 pounds of white arsenic are added and dissolved by vigorous stirring with a wooden paddle until the mixture cools. Two gallons of water are then added and the compound is ready for use.

The best results were obtained by splitting the stumps with an ax, brush hook, or machete, and applying the poison on the fresh cuts with mops made of old sacks tied to sticks about 24 inches long.

CHIMNEYS AND FIREPLACES, A. M. Daniels (U. S. Dept. Agr., Farmers' Bul. 1230 (1921), pp. 3-28, figs. 22), Washington, D. C. A compilation of semi-technical information is presented in this bulletin to aid the householder and prospective builder in the construction of chimneys and fireplaces.

TESTS OF HUMIDITY CONDITIONS IN A RESIDENCE HEATED BY A WARM-AIR FURNACE USING RECIRCULATED AIR, A. P. Kratz [*Journal American Society of Heating and Ventilating Engineers,* New York, 28 (1922), No. 1, pp. 11-20, figs. 6.] In a contribution from the University of Illinois studies are reported, the original object of which was to determine the evaporation rate of three different types of water pans for various rates of combustion in a warm-air residence furnace and also the effect of the location of the pan on the evaporation rate.

It was found that more water is evaporated per square inch of surface from a pan supported on the dome of a furnace than from pans placed around but not touching the fire pot. The best location for a crescent-shaped pan surrounding the fire pot was found to be midway between the casing and the fire pot. The crescent-shaped pan was not very effective in increasing the relative humidity. In tests with soft coal fuel the actual change was only from 23.6 to 28.4 per cent. At no time was frost or condensation observed on the outside glass with either of the above humidities.

Increasing the relative humidity made it possible to maintain the same difference in temperature between the air at the breathing line and the outside air with the use of lower register temperature.

The evaporation per square inch per twenty-four hours from the surface of the water in a crescent-shaped water pan surrounding but not touching the fire pot varied with the intensity of the radiation from the fuel bed. This in turn was found to be a function of the temperature and density of the fuel bed. The heat radiated from a hard coal fuel bed was much greater than that radiated from a soft coal fuel bed.

The coal consumption for a furnace in service was not materially decreased when the humidity was increased and the temperatures at the breathing line maintained constant. The air conditions were decidedly more satisfactory to the occupants of the test house after the installation of the crescent-shaped pan than before, notwithstanding the fact that the actual increase in relative humidity was small.

FARM DRAINAGE, W. L. Powers and W. Cretcher, [Oregon Agricultural Experiment Station (Corvallis) Bulletin 178(1921) pp. 3-47.] This bulletin describes different types of wet land in Oregon, points out the need and value of drainage for each type, and reports certain experiments to determine the most suitable depth, distance apart, and sizes for field drains. Data are also included on methods of installation and cost.

The chief wet soils of the state are said to be the white land of the Dayton soil series, the peat and muck soils of the marsh, tide, and overflowed areas, and the alkali areas of the irrigated sections. Studies of subsoil and ground water in white land generally show a friable streak of from 33 to 36-inch depth, and show also that tile placed in these areas have lowered the water table most promptly. The water table is lowered for 25 to 30 feet back from the tile within 24 hours after saturation. A depth of about 36 inches and distance between tile lines of from 60 to 66 feet have been found most effective for lateral drains in typical white land, while deeper drains are desirable in the less retentive areas.

Experiments indicate a suitable depth for tile to be 4 feet and a distance of 80 feet for tide land, while in irrigated lands as in Malheur Valley, drains from 8 to 9 feet deep have controlled the water table, a distance of 660 feet laterally.

Measurements of outflow in Williamette Valley indicate that main drains should have a capacity of from 1/3 to ½-acre-inch runoff to the acre in 24 hours for areas up to 40 acres and 1/3 inch for larger fields, as the total percentage of runoff in the Williamette Valley is large. On the coast ¾ to 1 inch is a suitable drainage coefficient.

REPORT ON INVESTIGATIONS INTO THE IMPROVEMENT OF RIVER DISCHARGE MEASUREMENTS, I. E. B. H. Wade [Egypt Ministry of Public Works, Physical Department Paper 4 published at Cairo, (1921), pp. VII + 21, pls. 18.] The author reports studies in which a so-called ratchet turbulence gauge was devised to detect errors in current meter ratings in flood waters due to nonuniform flow. The results obtained led to the conclusion that the errors due to turbulence are unimportant and that this holds for flood conditions in the Nile. In order that corrections may be applied for such errors if desirable it is noted that the observed errors in certain cases were less than 0.2 per cent, and it is considered utterly improbable that the error will amount to 2 per cent.

STRAW FILTERS FOR SEWAGE PURIFICATION, E. H. Richards and M. G. Weekes. [*Surveyor and Municipal and County Engineer,* (London) 60(1921), No. 1539, pp. 47, 48.] Laboratory experiments conducted at the Rothamsted Experimental Station are reported in which a dilute solution of ammonium carbonate (10 parts of nitrogen per 100,000) equal in strength to a very strong sewage were passed through a percolating filter of wheat straw at the rate of 250 gallons per cubic yard of straw per day. On the first day 5 per cent of the nitrogen passed on to the filter was removed, the amount increasing steadily up to the twentieth day, when only one per cent of the nitrogen in the artificial sewage was found in the effluent, the remaining 99 per cent remaining in the filter. The filter was then mature and continued to remove practically all the nitrogen fed to it until the saturation point was reached.

The filter continued to remove nitrogen until 7 parts had been fixed per 1000 parts of dry straw. On dismantling the filter the straw was found to have retained 86 per cent of the nitrogen contained in the original ammonia solution. Twenty per cent of the dry matter in the straw had disappeared in the process of fixation so that the nitrogen in the final dry matter had been raised to 1.33 per cent. The effluent was brown colored but nonputrefactive.

The experiments were repeated with actual sewage and practically the same results were obtained, as shown in the following table:

LABORATORY STRAW FILTER AND AMMONIUM CARBONATE

NITROGEN BALANCE

	GRAMS		GRAMS
Nitrogen added as $(NH_4)_2CO_3$	1.400	Nitrogen in effluent	0.121
Nitrogen in straw at start	0.759	Nitrogen in straw at end	1.965
		Nitrogen lost (3.4 per cent)	0.073
	2.159		2.159

Amount of added nitrogen fixed 86 per cent

LABORATORY STRAW FILTER AND SEWAGE

NITROGEN BALANCE

	GRAMS		GRAMS
Nitrogen as NH_3 in sewage	1.532	Nitrogen in effluent	0.149
Nitrogen in straw at start	0.877	Nitrogen in straw at end	1.976
		Nitrogen lost (11.8 per cent)	0.284
	2.409		2.409

Amount of added nitrogen fixed 72 per cent

It was found that when the straw has become saturated with nitrogen it can be removed from the filter and if stored in heaps will continue to ferment with great improvement in its physical state as a substitute for barnyard manure.

In further experiments it was attempted to apply straw filtration in the disposal of the sewage from a land reclamation camp containing three hundred persons. The sewage consisted of urine, cookhouse and ablution waste waters, and was considered to be of excessive concentration.

The original experiments had made it clear that clean straw was not active in removing nitrogen but that it gradually became more so as sewage was passed through it, the best results being obtained after twenty days of treatment; for this reason it was decided that the filter must be in sections and that the straw must be passed from section to section so that the sewage always met the newest straw first and finished by passing through the most active section. It was also decided that three sections would be sufficient, as this would give one section fully active and another nearly so, when clean straw had to be added.

After considerable experimentation a filter was designed in which the rate of sewage effluent flow to the straw was 96 gallons per cubic yard per day. With this scheme the best purification as measured by five days dissolved oxygen test was 80 per cent.

When a new tank of 960-gallon capacity was installed the improvement in nitrogen recovery was very marked. The best figure recorded was 65 per cent of the nitrogen in the sewage. On incubation for five days the effluent was invariably putrid. From such a strong liquid, ten times as strong as normal sewage, it is considered probably impossible to produce a nonputrescible effluent by straw filtration alone. The results are shown in the following table:

WAINFLEET STRAW FILTER

AVERAGE ANALYSES OF SAMPLES TAKEN AFTER INSTALLATION OF LARGER OVERHEAD TANK, JULY-SEPTEMBER, 1920

	PARTS PER 100 000 Sewage	Effluent
Ammoniacal nitrogen	18.92	10.19
Oxygen absorbed in four hours from permanganate	31.88	20.82
Dissolved oxygen taken up in five days	80.4	14.9
Chlorine	31.0	39.3

	DRY MATTER (per cent)
Total nitrogen in raw straw	0.50
Total nitrogen in straw removed from filter	1 62
Total nitrogen after storage for six months	2.06

It is concluded that in order to recover all the nitrogen possible from such sewage, about 2 pounds of dry straw per day per person is required. While 2,800 pounds of dry straw were used during a period of 35 days for the treatment of sewage containing 49 pounds of nitrogen, it was found by laboratory experiments that 5,000 pounds of straw are actually necessary to recover this amount of nitrogen. "Even if the rate of flow had been low enough to allow proper biological action, only about half the nitrogen could have been recovered. The straw removed was, in fact, overloaded with nitrogen all through the experiment.

"The resulting manure, after storage in a heap alongside the filter, was of excellent quality, containing 2.06 per cent of nitrogen, and was in good condition for applying to the soil. This manure has no smell whatsoever."

A STUDY OF THE BIOLOGY OF THE SPRINKLING SEWAGE FILTER, J. W. Thomson. [New Jersey Agricultural Experiment Station, New Brunswick, Bul. 352(1921), pp. 5-34, Figs. 18.] The results of a study conducted to gain a more definite knowledge of the relationship of the biological oxidative process in a sprinkling sewage filter and the gelatinous film present on the filter surfaces are reported. A special study was made of the organisms inhabiting the filter film.

It was found that organisms are present in the film of the sewage filter which are similar to those occurring in the soil and act to oxidize nitrogen from the ammonia to the nitrate and from the nitrate into the nitrate form. This process is a gradual one, starting in the top layer of the filter with the zone of greatest activity lying in the second layer.

A rapid decrease in the bacterial content of the sewage was found to occur as it passed over the stones of the filter, and at the same time there was a proportional increase in the bacterial content of the filter film. This result is taken to bear out the statement that the theory of absorption would apply to microscopic organisms as well as to complex chemical compounds. A very definite relationship was also established between the larger organisms inhabiting the film and the chemical activity of the filter.

Enzymes were found to be present in the film, acting to break up proteins into their more simple amino compounds and these amino compounds eventually into ammonia. It was also definitely proved that enzymes are present, which act to break down maltose, dextrose, and sucrose, but no lactose-splitting enzymes were found. A very active urease which split urea into ammonia and carbon dioxide was also found.

THE METALLURGIST AND THE TRACTOR, C. S. Moody. [*Journal of Society of Automotive Engineers*, 9 (1921), No. 3, pp. 189-192.] The author presents a comparison of the different materials available for tractor construction, and considers standard specifications. In regard to metallurgical problems it is pointed out that the first task of the designer is to determine the stresses in the various parts and their magnitude, this necessitating a true appreciation of shock and fatigue. The construction features of the different parts of the tractor are treated in general, and heat treating is considered in detail.

Annealing is used for removing strains, softening material, and for refinement of grain. With regard to heat treatment in general, it is stated that gears which carry little stress and wear need no treatment when made of cast iron, mild steel, or bronze. Where there is a large amount of wear and light stresses, light steel may be used which is carburized and treated by single or double quenching and then drawn. For extreme wear and high stresses alloy steel may be used which is carburized and given preliminary heat treatment, double quench, and draw. For high stresses and low wear, alloy steels are used with preliminary heat treatment, single oil quench, and draw. For extreme wear and stress, it is thought that a self-hardening alloy steel may be necessary, with even two preliminary heat treatments and an oil or air quench and draw.

TRACTOR TRIALS IN CEYLON, [*Tropical Agriculture* (Ceylon), 57 (1921), No. 1, pp. 3-8, pls. 5.] Plowing trials of four tractors to determine their relative merits for work upon cocoanut estates in the island of Ceylon are reported.

Each tractor was required to plow, cross plow, and disk harrow an area of 4.3 acres of old, hard, gravelly cocoanut soil to a depth of 6 inches and to within 2 feet of the trunks of the palms. The tractors used were the Saunderson, Cletrac, Avery, and Fordson. The Cletrac tractor plowed the greatest area per hour and the Fordson stood second in this respect. The Fordson, however, showed the lowest fuel consumption per acre plowed and the lowest total gross cost per acre. The soil plowed by the Saunderson tractor was somewhat harder than that of the other plats, and occasioned considerable difficulty in setting the plows. The Cletrac plowed the hard, gravelly soil without stopping and the depth and quality of the work improved with progress. The Avery tractor encountered a few soft, sandy patches of soil which caused much trouble. It used a double moldboard plow giving a 12-inch cut but was unable with this plow to reach the required depth of 6 inches except in the softer and sandier parts of the soil. The Fordson plowed in lighter soil than the other tractors but it was too hard for satisfactory work. Great difficulty was experienced in keeping the double furrow plow in the ground, and the plowing depth, except in sandy areas, did not average more than 2 inches.

INVESTIGATIONS IN DRY FARM TILLAGE, M. A. McCall and H. F. Holtz [Washington Station, Bulletin 164 (1921), pp. 56, figs. 12, Pullman.] In this bulletin experimental data are presented and discussed which are based on conditions as they exist in those parts in the State of Washington where the annual rainfall is 15 inches or less. The soil types in this region vary with elevation and rainfall, the sandier soils being found at the lower elevations as is also the lightest rainfall. The soil types range through sandy soils, fine sandy loams, very fine sandy loams, and silt loams. The sandier types are subject to drifting.

Field experiments were conducted on two series of 1/20-acre plats which were fallowed and cropped alternately, one series being in fallow and one in crop each year. All were treated the same except in preparing and maintaining the fallow.

In the localities in question moisture is the direct limiting factor in crop production, and the summer-fallow system of tillage for the conservation of moisture is necessary. Moisture conservation is said to depend on the absorption and retention of precipitation, and tillage operations should be planned to control these processes in so far as possible. In this district the regulation of absorption is considered to be the most important factor in determining tillage methods. With a light intermittent rainfall followed by drying winds a comparatively firm soil condition was found to favor absorption the most, while a loose soil condition hinders the process. Under conditions where a loose soil is unfavorable in moisture absorption the detrimental effect is in direct proportion to the loose soil.

At a moisture content near the field capillary capacity for a given soil type, the soil tends to settle or naturally refirm itself to the greatest degree after stirring. Under such conditions plowing or other tillage may be deeper without an equally detrimental effect on absorption. At a lower moisture content a soil tends to remain in looser condition after being stirred. As the moisture content of the plow layer diminishes it is pointed out that plowing or other tillage should be more shallow in order to avoid the detrimental effect of the loose soil or absorption.

The lower the average rainfall the more shallow should be the average depth of plowing. In general, depth of plowing should decrease with the advance of the spring season. Retention of moisture is best accomplished by early spring preparation of the fallow and the control of weeds. Variations in soil type and in the average annual rainfall give varying results from any specified operation or system.

STRESS-STRAIN MEASUREMENTS ON FILMS OF DRYING OILS, PAINTS, AND VARNISHES, H. A. Nelson [American Society for Testing Materials Proceeding, 21 (1921), pp. 1111-1134, figs. 12.] Methods and apparatus for making stress-strain measurements of paint and oil films are described, and the results of actual tests are reported to show the properties of films and their modification under the influence of moisture and temperature variations, light, and other agencies. It was found that width of test specimens is not a factor in the numerical results of a test, provided the rate at which the load is applied is calculated to the same number of grains per square centimeter of cross-sectional area per minute.

Duplication of thickness over any considerable area is largely a matter of chance. It was found that films of varnish and enamel are more uniform in thickness than paint films.

The ultimate elongation varies inversely, and the ultimate tensile strength varies directly as the rate of application of the load. Curves indicating the relation between ultimate tensile strengths and rates of loading showed that (1) the slopes of the curves vary directly as the ultimate tensile strength, (2) within the most practical working range of from 10,000 to 30,000 grams per square centimeter per minute, the relation is practically linear, and (3) the ultimate tensile strength at infinitely slow rates may be obtained rather easily by extrapolation from observations made at three or four different rates. A rate of loading of 15,000 grams per square centimeter per minute was found to be the optimum for ordinary tests.

The moisture absorbed by paint films will vary in amount, depending on the age of the film and its composition, the maximum found being about 2 per cent by weight.

Much qualitative evidence was obtained that changes in temperature affect the physical properties of films to a considerable extent. For testing purposes, 25° Centigrade was accepted as a standard temperature for desiccation and for the atmosphere surrounding the testing apparatus.

Studies of actual stress-strain curves of enamel, paint, oil, and varnish mixtures and of rubber for comparison showed them to be of parabolic form, corresponding to the formula $y = ax^n$, in which y = strain, x = stress, and a and n are constants depending upon the stage of oxidation attained by the film. The data indicate that within experimental error the freshly formed linseed oil film approximates perfect elasticity. They also show that (1) in the presence of oxygen the entire process of the appearance of the solid phase when a drying oil takes on structure is normally progressive, (2) the highly unsaturated compounds in the oil will undergo most rapid oxidation, and (3) as oxidation proceeds the film becomes more resistant to distortion and generally loses its high elastic property.

The paint film may be considered in a similar manner. But the enormous surfaces exposed by the pigment and the small interparticle distances encourage rapid oxidation, with the result that the oxidized solid phase in a few days reaches a stage of oxidation which requires months on the part of a film of ordinary bodied linseed oil, unless under the influence of a catalyst. If the paint film ever approaches perfect elasticity and obeys Hooke's law, it must be very early in the stage of oxidation.

Varnish vehicles are usually so treated during the process of manufacture and incorporation that extensive oxidation of a portion of the vehicle has already taken place. Also, the colloidal gums present expose tremendously greater surfaces to the oxidizing binder, resulting in higher resistance to distortion at an early stage in the life of the film.

China wood oil exterior varnishes present a variation from the above. There appears the same increased resistance to distortion at early stages, and also the same accelerated distortion throughout the upward sweep of the stress-strain curve. But instead of breaking off short, the remaining structure, which has retained its high extensive properties, having submitted to distortion to the limit, shows sufficiently high tenacity or structural property to resist final rupture.

"All of the evidence and argument so far presented makes the presence of any measurable elastic limit in films of highly oxidized linseed oil and any paint or varnish seem improbable. At most, the true elastic limit can only be that of the most highly oxidized material which will attain its elastic limit first."

During investigations of variations in the form of the stress-strain curve, increasing evidence was obtained that by abnormal treatment with moisture and temperature variations films can be made to deviate entirely from the normal stress-strain curve.

It is concluded that the amount of distortion to which a film will submit before rupturing appears to be a characteristic property depending on the components of the film and the stage of oxidation or deterioration and therefore cannot be considered to any extent apart from specific tests. Films of common paints and varnishes generally lose in ultimate elongation and gain in tensile strength as normal oxidation proceeds. But notable exceptions to this has been observed in the case of better grade varnishes which will often hold a very constant ultimate elongation throughout a long period of oxidation during which time the tensile strength increases steadily.

PRACTICAL STRUCTURAL DESIGN, E. McCullough [U. P. C. Book Co., Inc., New York, 1921, 2. ed. rev. and enl., pp. 317, figs. 196.] This is a reference work for engineers, architects, and builders. It contains chapters on external forces, internal forces, problems in design of beams, girders and trusses, joints and connections, graphic statics, columns and structures, and semirigid frames.

INVESTIGATION OF WARM AIR FURNACES AND HEATING SYSTEMS, A. C. Willard, A. P. Kratz, and V.S. Day [Illinois University, Engineering Experiment Station Bulletin, 120 (1921), pp. 145, figs. 50.] This is a progress report of the work on warm-air furnace research which is being conducted by the University of Illinois in cooperation with the National Warm Air Heating and Ventilating Association.

A rather detailed description of the extensive apparatus and of the more important features thereof is first given and graphic data on tests of piped and pipeless furnace plants are presented. This is followed by a detailed discussion of methods of testing, precise measurement, and of general procedure which are in process of development, together with some of the results obtained to date. The studies of piped furnaces have so far shown that the design of a furnace heating system must be based on the British thermal unit loss per hour from each room.

Studies of twelve pipeless furnaces showed the relations between and the importance in design of rate of combustion, efficiency, capacity in British thermal units per hour, equivalent register temperature of air leaving register based upon 65° Fahrenheit inlet temperature, and draft in inches of water. It is shown that capacity is dependent entirely on draft for a given furnace and a given coal and that high capacity is sometimes attained at a loss in efficiency. It was further found that the slotted fire pot should not be used with hard coal as fuel. In studies of casings for pipeless furnaces the best results were obtained with a furnace having a double inner casing with a one inch air space. The proper height from the floor for the bottom of the inner casing was found to be from seven to nine inches.

In proportioning the registers for a pipeless furnace, a logical rule seems to be that the mean between the warm-air throat area and the free area of the warm-air register face should be equal to the minimum free area of the warm-air space across the inner casing.

Studies of heat losses from a pipeless furnace showed that of the total loss, 48.3 per cent was lost from the furnace front, 26.5 per cent from the concrete floor, 7.05 per cent from the lower casing below the shield, and 18.15 per cent from the upper casing.

A continuation of the studies on the emissivity of heat from various surfaces presented very convincing evidence against the use of thin layers of asbestos paper covering on bright tin pipes. The heat loss was 62 per cent greater with one thickness of the paper covering a bright tin pipe than when the same pipe was left uncovered, which resulted in a waste of 5 per cent or more of the coal consumed. Eight thicknesses of the paper were necessary to reduce the heat loss below that from a bare, bright tin specimen.

Studies of heating surfaces in which two sets of tests with hard coal and two with soft coal were run with slots in the fire pots closed and open showed that for any particular furnace and for a given temperature rise, all other conditions remaining the same, the castings will give off a greater amount of heat in a unit time for a hard coal fire and a fire pot with slots closed than they will for a hard coal fire with the slots open or for soft coal fires under any conditions.

Preliminary studies on the effect of increasing the velocity of the air over the heating surfaces showed that by using a fan and positive circulation it appeared possible to increase the capacity of a pipeless furnace to from two to three times the capacity on natural circulation. A comparison of fire pots with open and closed slots showed that in the case of a hard coal fire with the slots in the fire pot open, the capacity and efficiency were very materially reduced.

A. S. A. E. and Related Activities

Farm Building Design Committee

IN THE list of A. S. A. E. committees for 1922 published in the March number of AGRICULTURAL ENGINEERING the personnel of the Committee on Farm Building Design was not complete. This committee is now complete and President A. J. R. Curtis announces the appointments as follows: W. A Foster, Iowa State College, chairman, A. W. Clyde, Iowa State College; C. S. Whitnah, King Ventilating Company; E. A. Stewart, University of Minnesota; R. W. Trullinger, States Relation Service, U. S. Department of Agriculture; and H. R. Straight, Adel Clay Products Company.

Personal Items of Members

STANLEY F. MORSE, consulting agricultural engineer, announces that he has opened an office at 82 Wall Street, New York City, and is in position to serve companies and individuals interested in commercial farms, plantations, ranches, or lands needing development or increased profits in this or foreign countries. The service offered includes consultations, examinations and reports, special technical investigations, plans, estimates, supervision and management. Special attention is given to large scale propositions involving sugar, cotton, rice, rubber, coffee, wheat, fruits, cattle, and tropical agriculture. The southern office will continue to be handled by the Morse Agricultural Service, 1412 Hibernia Building, New Orleans.

Ohio State Student Branch Activities

WORD received from the secretary of the student branch of the American Society of Agricultural Engineers at Ohio State University indicates that the organization has been very active during the present school year and has made a name not only for itself at the Ohio State University but for the Society as well.

Several films loaned by tractor companies have been shown at business meetings of the branch. At an open meeting Prof. Bear of the soils department gave a lecture on how to lengthen the growing season by drainage. Dean Vivian of the college of agriculture also gave a lecture on "The Modern Farm."

At the annual "Ag. Open Nite" the student branch put on a stunt, entitled "The Universal Household Maid." This event is an annual affair in which the agricultural college students get together for an evening of entertainment, each society on the campus putting on one original stunt.

A few weeks previous to the event there was held at the University a "Dads Day," in which the students invited their fathers to visit them and attend the Ohio State-Purdue football game. The stunt put on by the A. S. A. E. student branch was taken from the "Dads Day" idea. Old Jud Slocum arrives home from the "Dads Day" event at the Ohio State University and tells his wife Miranda of the sights he saw at the University, particularly, while visiting the agricultural-engineering department, of the wonderful machine which would do anything.

This machine as constructed by the students consisted of a large box of Beaver board in the lower corner of which was placed a motor belted to a large wheel. The outside of the box had a few lights to add to its attractiveness. With the machine in operation a negro boy was put in the hopper and a white boy well groomed came out the other end. A sack of flour was also placed in the hopper along with some yeast and water and after a few discharges of flashlight powder the red light was turned on and two well-baked loaves of bread were discharged. A collie dog was put in the hopper and after a tremendous amount of racket and grinding about five feet of weiners was discharged at the other end. Two baskets of sawdust were placed in the hopper and there came out at the other end a number of boards, a chair, and various wood products. The machine was also capable of washing, in which all the dirty overalls of the agricultural engineers were run through and clean towels and sheets were discharged. To finish the stunt a number of large firecrackers were set off and the machine exploded and exposed the interior and contents showing the men inside handing out the finished products and what had been going on inside the box.

Ventilation of Room Type Incubator

EDITOR AGRICULTURAL ENGINEERING:

DO YOU have anyone in connection with the American Society of Agricultural Engineers who is posted on the ventilation of the new room-type incubator? We have a man in our county who is needing such help and I want to take this matter up with the proper person if I can locate him.

J. D. VAN HOUTEN

County Agricultural Agent

EDITOR'S NOTE: Members of the Society who have information on the ventilation of room-type incubators or know of sources of information on this subject are requested to communicate with the Secretary. Prompt action will be appreciated. In addition to sending such information to Mr. Van Houten, the Secretary would like to have it also for the reference files of the Society and for publishing in AGRICULTURAL ENGINEERING, inasmuch as there are no doubt a number of other members of the Society who would be interested in securing such information.

Economic Use of Windmill

EDITOR AGRICULTURAL ENGINEERING:

I AM very anxious to find some definite information on the economic use of the windmill for pumping water. Is there some way to decide whether it is profitable to use the windmill in preference to the gas engine? Can you give me any references or information, or refer me to some person whom you know has done work in this line?

W. R. WHITE

EDITOR'S NOTE: Members of the Society who have investigated the economic use of windmills for pumping water or know of such investigations or of sources of information on this subject are requested to send the Secretary what information they have. Prompt attention to furnishing the desired information will be appreciated. In addition to sending such information on to Mr. White, the Secretary would like to have it also for the reference files of the Society and for publishing the information in AGRICULTURAL ENGINEERING, inasmuch as there are no doubt a number of other members of the Society who would be interested in securing information on this particular subject.

Work of American Engineering Standards Committee

THE 1921 report of the work of the American Engineering Standards Committee has just been published. The purpose of this organization is to serve as the national clearing house for engineering and industrial standardization, to act as the official channel of cooperation in international standardization, and to provide an information

service on engineering and industrial standardization matters. Definite responsibility for the control of the work rests with the organizations whose representatives constitute the American Engineering Standards Committee. At present these include five departments of the federal government, nine national engineering societies, and fourteen national industrial associations. This committee functions as a clearing house rather than as a creator of standards. Its work, therefore, necessarily centers in bringing about systematic cooperation of the organized bodies, technical, industrial, and governmental, which speak for industry.

At the time of the organization of the American Engineering Standards Committee, there were more than one hundred organizations publishing engineering standards, most of which were formulated without systematic methods of cooperation between the organizations concerned. At the present time one hundred and sixty organizations are actively cooperating in the work of the committee, having appointed accredited representatives to serve on sectional committees.

The American Engineering Standards Committee had its beginning on January 17, 1917, at the meeting of a special committee appointed jointly by the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Society for Testing Materials, for the formulation of some method of cooperation to prevent duplication in standardization work and the promulgation of conflicting standards. As the result of this and subsequent meetings the American Engineering Standards Committee was organized, made up of representatives of the five societies mentioned. The first meeting was held October 19, 1918. Later, upon invitation, the government departments of war, navy, and commerce designated representatives to serve on the committee. In 1919 the constitution was broadened to permit the representation of international bodies on the committee.

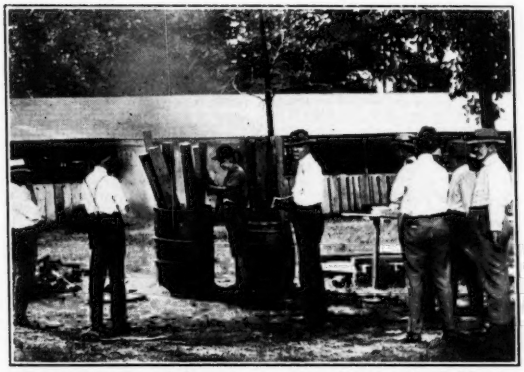
The report states that during the year ending December 31, 1921, the American Engineering Standards Committee approved fifteen standards as follows: Specifications and tests for Portland cement; safety code for the protection of the heads and eyes of industrial workers; standard method for distillation of bituminous materials suitable for road treatment; standard method for sampling coal; standard test for toughness of rock; national electrical code; specifications for soft or annealed copper wire; specifications for lake copper wire bars, cakes, slabs, billets, ingots, and ingot bars; specifications for electrolytic copper wire bars, cakes, slabs, billets, ingots and ingot bars; methods of battery assay of copper; specifications for cold-drawn Bessemer steel automatic screw stock; specifications for cold-drawn open-hearth automatic screw stock; methods of chemical analysis of manganese bronze; methods of chemical analysis of gun metal; industrial lighting safety code.

Seventeen standards were formally before the committee for approval on December 31, 1921. Of these fifteen were submitted under a special rule of the committee which provides for standards already in existence, and two have gone through the process of development by a sectional committee. Those submitted for approval as American Standards are: Standards of the American Institute of Electrical Engineers and Electrical Safety Code ("National Electrical Safety Code.") Those submitted for approval as tentative American Standards are Specifications for carbon steel and alloy steel forgings; specifications for quenched and tempered alloy steel axles, shafts and other forgings for locomotives; specifications for carbon steel car and tender axles; standard specifications for drain tile; specifications for testing and use of permissible explosives for use in mines; automobile headlighting specifications; dimensional motion picture standards; safety rules for installing and using electrical equipment in bituminous coal mines; portable electric mine lamps; storage battery locomotives for use in gaseous mines; methods of test for the penetration of bituminous materials; safety code for the use, care and protection of abrasive wheels; and foundry safety code.

At the present time there are seventy-nine projects which have an official status before the American Engineering Society. In addition to these there is in the files of the committee correspondence relating to more than fifty subjects, the standardization of which has been informally suggested or proposed. The list of the seventy-nine projects follows: Safety code for building exits; color scheme for pipe lines; safety code for construction work; specifications for drain tile; elevators; safety code for elevators and escalators; specifications for fire tests of materials and construction; safety code for floor openings, railings, and toe boards; safety code for industrial lighting; safety code for ladders; specifications and tests for Portland cement; structural steel shapes; standard tests for toughness of rock; methods of testing wood; safety code for use in the care and protection of abrasive wheels; ball bearings; safety code for compressed air machinery; safety code for foundries; gauges, plain limit, for general engineering work; gears; safety code for logging and sawmill machinery; safety code for machine tools; safety code for mechanical power transmission apparatus; safety code for mechanical refrigeration; safety code for paper and pulp mills; pipe flanges and fittings; pipe threads; safety code for power presses; screw threads; shafting; small tools and machine tool elements; width across flat on nut and bolt heads; safety code for woodworking machinery; electrical properties of aluminum; electrical fire code for wiring apparatus; electrical fire and safety code; electrical safety code (national electrical safety code); safety code for electrical power control; rules for electricity meters (code for electricity meters); fundamental electrical standardization rules, including rules for rotating machines, electric railways, transformers, switching and control apparatus, meters and instruments, wires and cables, telephony and telegraphy; insulated wires and cables (other than telephone and telegraph); safety code for lightning protection; rating of electrical machinery; symbols for electrical equipment of buildings and ships; terminal markings for electrical apparatus; safety code for aeronautics; automobile headlighting specifications; railroad tie specifications; electrical installations on shipboard; specifications for carbon steel and alloy steel forgings; specifications for carbon steel car and tender axles; specifications for carbon steel forgings for locomotives; specifications for cold-drawn Bessemer steel automatic screw stock; specifications for cold-drawn open-hearth steel automatic screw stock; specifications for quenched and tempered alloy steel axles, shafts, and other forgings for locomotives and cars; specifications for quenched and tempered carbon steel axles, shafts, and other forgings for locomotives and cars; methods of battery assay of copper; specifications for electrolytic copper wire bars, gates, slabs, billets, ingots, and ingot bars; specifications for soft or annealed copper wire; zinc and zinc ores; methods for chemical analysis of gun metal; methods for chemical analysis of manganese bronze; explosives safety code; gas safety code; safety code for textiles; portable electric mine lamps; safety rules for installation and use of electrical equipment in bituminous coal mines; storage battery locomotives in use in gaseous mines; specifications for the testing and use of explosives; abbreviations in engineering work; dimensional motion picture standards; methods for distillation of bituminous materials suitable for road treatment; safety code for industrial sanitation; method of test for the penetration of bituminous materials; safety code for the protection of the heads and eyes of industrial workers; method for sampling of coal;

Carbosoting fence-posts cut from farmers' wood-lots at G. R. & I. Railway Demonstration Farm under auspices of Michigan Agricultural College.

Exhibit at Iowa State College, Ames, Iowa, of willow, cotton-wood, soft maple, etc., posts creosoted in 1907. Those still in service indicate a life of at least 20 years.



Demonstration of how to preserve fence-posts held at Fulton County (Kentucky) Fair. Durable posts require butt treatment only. Non-durable posts should be entirely treated—hot treatment for butt followed by cold treatment of entire post.

Are you teaching the value of wood preservation?

MANY colleges and county agricultural agents are now teaching the value of creosoting fence-posts. And demonstrations and exhibits, like those shown in the illustrations, are bringing home to the farmers the practical simplicity of such preservative treatments.

Beneficial though this work is, it is only the first step toward timber conservation on the farm.

Farmers use about 46% of the nation's total annual production of building lumber. And, as you know from personal observation, a large portion of it is used to repair or replace parts of wooden structures that have failed because of premature and preventable decay.

It is, therefore, of the utmost importance that farmers be taught to apply preservative treatment to structural timber, as well as to fence-posts.

Sills; foundation posts; columns and uprights of barns, sheds and other buildings; hog houses, poultry houses, and similar structures—all may be made more durable and less expensive to maintain, by the application of simple, non-pressure preservative treatments.

Carbosota, which is a highly refined and specially processed grade of pure coal-tar creosote oil, is recognized as the standard preservative for all non-pressure treatments.

Write for our bulletin—"Long Life for Wood." It contains valuable suggestions and recommendations. If you desire, we will gladly supply you with enough copies for distribution to your farmer correspondents.

The Barrett Company

New York	Chicago	Philadelphia	Boston	St. Louis	Cleveland
Cincinnati	Pittsburgh	Detroit	New Orleans	Birmingham	Kansas City
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Barrett Carbosota For Preserving Wood

safety code for tanneries; safety code for ventilation.

Copies of the 1921 report of the American Engineering Standards Committee may be obtained without charge upon request to the Committee at 29 West Thirty-ninth street, New York City.

Wanted—Correct Addresses of These A. S. A. E. Members

NOTE: Mail is being returned from the addresses given below. These members, or others who know of their whereabouts, are requested to send the Secretary their correct addresses at once. Inasmuch as delivery cannot now be made, AGRICULTURAL ENGINEERING will not be mailed until correct addresses are received.

George J. Baker, 112 Theodore Street, Detroit, Michigan.

Claude S. Bristow, Elks Club, Portland, Oregon.

Joaquim Bertino de Moraes Carvalho, Directoria Geral da Industria Pastoril, Rua Matta Machado, Rio de Janeiro, Brazil.

George Collins, 461 Market Street, San Francisco, California.

D. M. Emery, Illinois Hotel, Bloomington, Illinois.

F. K. Flynn, 1 Main Street, Watertown, Wisconsin.

K. D. Hequembourg, 531 W. 112th St., New York City.

W. C. Kreuger, North Carolina Agricultural College, Raleigh, North Carolina.

A. M. Leoni, 3832 Reisterstown Road, Baltimore, Maryland.

J. T. Montgomery, Alva, Oklahoma.

Arthur H. Pearsoll, 1350 Rosedale Avenue, Chicago, Illinois.

John Howard Rees, 2211 Commerce Building, Columbus, Ohio.

S. Y. Sweeney, 111 East Campbell Avenue, Roanoke, Virginia.

T. A. Toenjes, 1115 South Street, Waterloo, Iowa.

George G. Whitfield, Demopolis, Alabama.

R. S. Whiting, 908 Galt Avenue, Chicago, Illinois.

J. C. Weidrich, c/o Dempsey Hotel, Davenport, Iowa.

New Members of the Society

SANDS CALHOUN, salesman Elmira office, James Manufacturing Company, Jersey City, New Jersey.

LEROY LEMAYNE HIDINGER, president, Morgan Engineering Company, Memphis, Tennessee.

WILLIAM ARMSBY MURRAY, salesman of barn equipment, James Manufacturing Company, Elmira, New York. Mail address 1323 West North Avenue, Baltimore, Maryland.

CONRAD ROGER NEFF, University Station, Baton Rouge, Louisiana.

RICHARD G. PEEPLES, Arizona Equitable Rating Office, 711 Heard Building, Phoenix, Arizona.

FREDERICK H. SCHREINER, Bank of Commerce and Trust Company, Memphis, Tennessee.

FRANCIS G. SHAW, engineer, International Harvester Company, 155 Avenue du General Michel Bizot—Paris XII, France.

CLAUDE O. STREETER, mechanical engineer, Graton & Knight Manufacturing Company, Worcester, Massachusetts.

PAUL HANSON SWANSON, 152 West Vine Street, Owatonna, Minnesota.

WALTER VAN HAITSMA, Federal Building, Port Huron, Michigan.

MILO BEYER WILLIAMS, consulting agricultural engineer, 2705 Piedmont Avenue, Berkeley, California.

TRANSFER OF GRADE

EVAN ALAN HARDY, University of Saskatchewan, Saskatoon, Saskatchewan. (Student Branch to Junior Member)

R. B. LUNDY, RFD No. 1, Box 151, San Jose, California. (Junior to Associate Member)

A. B. SCHMIDT, Carbondale, Kansas. (Student Branch to Junior Member)

Applicants for Membership

The following is a list of applicants for membership received since the publication of the March issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to the applicants for the consideration of the Council prior to their election.

Fred J. Kritzer, chief of the plan service department, James Manufacturing Company, Elmira, New York.

George Edwin Oliver, Onawa, Iowa.

Allen Clement Wolff, Weyburn, Saskatchewan, Canada.

EMPLOYMENT SERVICE

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members, as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

The Secretary receives several times each month from The Federated American Engineering Societies a bulletin listing the "positions open" which are reported to the F.A.E.S. Employment Service by member engineering societies. Copies of this bulletin are sent to the "men available" listed below, or other members seeking employment, as soon as received.

Men Available

AGRICULTURAL ENGINEER wants position as experimental agricultural engineer or with some agricultural publication. Graduate, 1918, agricultural college of the University of Illinois. Was editor of the Illinois agricultural students publication in his senior year. For two years employed by an explosives manufacturer as agricultural sales and service man for the State of Wisconsin. At present associated with the land clearing department of the University of Wisconsin. Age 25, married, American. MA-101

AGRICULTURAL AND CHEMICAL ENGINEER, with several years experience in research and experimental work, both in agricultural and chemical lines, desires a position on an agricultural experiment station staff or in some phases of agricultural engineering work. MA-102.

MECHANICAL AND ELECTRICAL ENGINEER, graduate of Cornell University and Armour Institute, with nineteen years of practical experience in designing, manufacturing, and marketing gasoline engines, automobiles, motor trucks and tractors, having specialized particularly on internal-combustion motors and their application, prefers mechanical work cooperating with the different manufacturing and sales departments along the lines of sales engineering, or other work into which his qualifications would fit. MA-104

AGRICULTURAL GRADUATE (1916) from the Mississippi A. & M. College with the degree of B.S.A., formerly connected with the U. S. Department of Agriculture, in military service September, 1917 to June, 1919, and more recently a cotton planter, wants a position as instructor in some branch of agriculture. MA-105

AGRICULTURAL ENGINEER wants position in southwest. Graduate of University of Illinois 1915, five years practical experience on Illinois farm with power equipment, two years in charge of the agricultural engineering department New Mexico College of Agriculture; considerable garage experience and service experience on unit power and light plants. Also one summer in Philadelphia battery service station. MA-106

AGRICULTURAL ENGINEER, graduate from the agricultural engineering course of the Iowa State College, who has had a great deal of experience in sewer work and farm building construction in the southern states, is interested in securing employment with a firm specializing on farm structures or farm sanitation. MA-107

AGRICULTURAL ENGINEER, graduate in agriculture at Cornell and trained in mechanical and electrical engineering, at present assistant professor of rural engineering at an agricultural college, wants position in the same or related field. Six years teaching experience and about six years engineering experience with telephones, milking machines, field machinery, concrete pipe making machinery and gas engines. Thoroughly trained in automotive theory and practice, including repair. MA-108

AGRICULTURAL ENGINEER wants position on a farm or with some firm where an engineering and general agricultural training is required. Will graduate from the agricultural college of the Ohio State University in June 1922. Major work done in agricultural engineering and farm management. Born and raised on farm. Age 22. Unmarried. MA-109.

AGRICULTURAL ENGINEER, graduate in mechanical engineering at Michigan Agricultural College, desires position teaching all kinds of farm machinery or automotive work, or with some farm-equipment manufacturer. Will be available April 1, 1922. Has served one year as instructor in tractors and trucks, and one year conducting service schools for a leading tractor manufacturer. Can furnish best of references. MA-110

AGRICULTURAL ENGINEER, graduate of Iowa State College 1920, with several years of practical experience farming with machinery and one year's teaching experience in high school, wants employment on a large farm or in college teaching of power farming. Twenty-five years of age. Married. MA-111

Positions Available

INSTRUCTOR IN POWER FARMING. The department of agricultural engineering of the Virginia Polytechnic Institute, Blacksburg, Virginia, wants a man qualified to teach farm implements, motors, motor vehicles, and rural sanitary equipment. Applicants should write direct to Charles E. Seitz, head of the department. PA-1